The ROV project surveyed South Coast ecosystem types that exist below depths that scuba divers can efficiently survey. *Mid-depth rock* ecosystems exist between 30 and 100 meters (m), while *subtidal soft-bottom* ecosystems extend from 0 to 100m, and *deep and canyon* ecosystems occur below 100m and can have either rocky or soft substrates. These ecosystems are home to many commercially and ecologically important species. Rockfishes and Lingcod can be found over rocky substrate, and flatfishes and ridgeback prawns can be found over the more abundant soft substrate. Species that inhabit these dark waters, especially on rocky substrate, tend to be long-lived and slow-growing, including habitat-forming sessile invertebrates such as sea fans and corals that are especially sensitive to physical disturbance. We have only begun to explore and grow our understanding of these deep, dark ecosystems off the California coast.

### About This Snapshot Report

This report highlights some key scientific findings from the subtidal remotely operated vehicle (ROV) monitoring project, one of ten baseline projects in California's South Coast region.¹ This project characterized mid-depth rock, subtidal soft-bottom, and deep and canyon ecosystems at selected locations around the time of marine protected area (MPA) implementation. Facts and figures are derived from the project’s peer-reviewed technical report,² which can be found, along with the related data, at OceanSpaces.org.

### LIFE IN THE DEEP

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### Ups and Downs: Monitoring with ROVs

ROVs are a non-destructive way to observe species and communities at depths not easily accessible to divers. They create a permanent data archive through their real time video and photographic imaging and recording systems, which can be verified and re-evaluated at any time. They can also be outfitted with sensors to record associated data such as temperature, depth, and dissolved oxygen. Researchers noted that ROVs can be expensive, and the deployment and analysis of footage is time- and labor-intensive. Their use can be complicated by entanglement risk (e.g., thick kelp or fishing gear), or by poor visibility. Both the strengths and challenges of using ROVs should be considered in planning for long-term monitoring.

### A Collaborative Effort

This project represents a successful collaboration between academic scientists at the Institute for Applied Marine Ecology (IfAME),³ scientists and engineers at the non-profit organization Marine Applied Research and Exploration (MARE),⁴ and members of the commercial fishing community (F/V Donna Kathleen and her crew). Together, researchers collected video and still imagery using an ROV at four locations representing the biogeographic zones across the South Coast. By combining these images with map products from the California Seafloor and Coastal Mapping Project funded by the Ocean Protection Council (OPC), researchers described the ecological characteristics inside and outside of selected State Marine Reserves (SMRs) and State Marine Conservation Areas (SMCAs) at the time of South Coast MPA implementation.
Characterizing Deep Ecosystems: Transects at Four Key Sites

Point Vicente
Depth range surveyed: 10 – 175m
Substrate: primarily soft

Santa Catalina Island
Depth range surveyed: 13 – 229m
Substrate: soft, hard, mixed

Fish species/species groups identified:

Point Vicente
- 37

Santa Catalina Island
- 52

Individual fish identified:

Point Vicente
- 15,892

Santa Catalina Island
- 11,898

Most abundant fish species:

Point Vicente
- Halfbanded Rockfish (83% of identified fish)

Santa Catalina Island
- Blacksmith (28% of identified fish)

Other abundant fish:

Point Vicente
- Flatfish
- Combfish

Santa Catalina Island
- Squarespot Rockfish
- Flatfish

Commonly observed invertebrates:

Point Vicente
- Ridgeback prawns
- Octopuses
- Sea cucumbers
- Sea pens/whips

Santa Catalina Island
- Sea cucumbers
- Hydrocoral
- Octopuses

Fish species only identified at this site:

Point Vicente
- Sebastolobus spp.
- Bearded Eelpout

Santa Catalina Island
- English Sole
- Spotted Ratfish

Multiple transects were conducted at each study site, and while transect length depended on local conditions, they were usually longer than 1km.

The ROV used in this study, the Beagle, is outfitted with numerous video and still cameras and various sensors. It was controlled by human operators onboard the F/V Donna Kathleen. Researchers “flew” the Beagle at an approximate speed of 1 ft/sec roughly 3 ft above the seafloor.

Transects Explained

Three types of transects were conducted during this study: normal, vertical, and elevator. During normal transects, the Beagle was flown along a section of the seafloor with a constant depth for the duration of the transect. Data collected from normal transects were summarized by study site. Vertical transects were similar to normal transects, except the Beagle was flown up-slope from the edge of the continental shelf. Vertical transects were also conducted at all four study sites, but they were analyzed separately from the normal transects. In order to explore the walls of La Jolla Canyon, researchers developed a new “elevator” protocol in which the Beagle was flown straight up the canyon wall. Elevator transects were analyzed separately from all other transects.

The above display is seen by operators when the ROV is in use, and this video footage is later watched by researchers who collect data on the species and habitats observed. The data is stored in a database, and the footage is archived for later use.

3 species of sharks and skates

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Tim Maricich
Exploring La Jolla Canyon with Elevator Transects

La Jolla Canyon is a key feature of the La Jolla Study Area. Researchers identified 37 fish species or species groups, including 15 rockfish species. They analyzed the data to see which physical factors were the best predictors of species richness and abundance. Depth is the most important predictor of species richness, while slope and rugosity (roughness) of the canyon walls were the best predictors of abundance. For example, the deepest portions of the canyon transects, which were over 200m below the surface, had the greatest species richness but the lowest overall abundance. Some species were evenly distributed across depth ranges, such as Halfbanded Rockfish and California Lizardfish, while some were only observed at the greatest depths, such as Hundred Fathom Codling.

Fish species/species groups identified:

La Jolla
Depth range surveyed: 10 – 252m
Fish species/species groups identified: 40
Individual fish identified: 15,010
Most abundant fish species: Halfbanded Rockfish (83% of identified fish)
Other abundant fish: California Lizardfish, Shortbelly Rockfish
Commonly observed invertebrates: Crabs, Spot prawns, Octopuses
Fish species only identified at this site: Brown Rockfish, Pipefish, Fantail Sole, Chilipepper Rockfish

Laguna Beach
Depth range surveyed: 10 – 107m
Fish species/species groups identified: 21
Individual fish identified: 973
Most abundant fish species: Blacksmith (50% of identified fish)
Other abundant fish: Garibaldi, Flatfish
Commonly observed invertebrates: Gorgonians, Anemones, Crabs, Octopuses
Fish species only identified at this site: California Tonguefish, Barred Sand Bass

San Diego–Scripps Coastal SMCA
Matlahuayl SMR
Laguna Beach SMR
Laguna Beach
SMCA (no take)
Dana Point SMCA
Crystal Cove SMCA

The number of species increased below 200m (greater richness), but there were fewer total fish (lower abundance).
Examining Depth Distributions with Vertical Transects

To explore the distribution of fishes and invertebrates across depths, additional “vertical” transects were conducted at all four study sites. Survey depths ranged from 50–400m. Some fish were most common at the deepest parts of the transects, such as Aurora/Splitnose Rockfish and Dogface Witch-eel, which were observed at their greatest density between 300 and 400m. Other fish were more common in the shallower portions of the transects, such as Halfbanded Rockfish, which had their greatest density at 50m. Mobile invertebrates most commonly observed on the vertical transects included squat lobsters, octopuses, and prawns. Squat lobsters reached their peak density at 260m and were observed over a relatively narrow depth range, while octopuses were observed across the entire depth range but at low densities.

Prawn Distributions: Steep and Deep

Spot prawns and ridgeback prawns are commercially important species. Researchers analyzed the distribution of prawns across all four study sites to characterize their habitat preferences. Ridgeback prawns were most commonly observed at depths of 140–200m and at slopes of 10–20°. Spot prawns seemed to prefer deeper and steeper conditions, and were most commonly observed at depths of 160–220m and slopes of 25–45°.

About South Coast MPA Baseline Monitoring

California Ocean Science Trust, California Department of Fish and Wildlife (CDFW), California Ocean Protection Council (OPC), and California Sea Grant coordinated and collaborated in the implementation of baseline monitoring, which was funded by OPC. Results from this work will inform CDFW management recommendations to the California Fish and Game Commission from the first five years of MPA implementation in the region, anticipated in 2017. MPA monitoring results can also inform the management of fisheries, water quality, coastal development, and climate change.

Footnotes
1. http://oceanspaces.org/sc-deep